Physics for OI - lectures:

1.   Motivation of the subject. Description of physical systems. Physical quantities, dimensional analysis. Scalar and vector quantities, scalar and vector field. Physical meaning of the scalar and vector product..

2.   Evaluation of physical quantities by derivations and integrals. Kinematics.

3.   Basics of vector calculus. Laplace and Fourier transform.

4.   Newton's laws of motion. Equation of motion. Laplace image of the solution of equation of motion.

5.   Motion description by differential equations.

6.   Work, power, conservative fields, kinetic and potential energy. Conservation of mechanical energy law.

7.   Mechanical oscillating systems. Simple harmonic motion, damped oscillations.

8.   Forced oscillations. Resonance of displacement and velocity.

9.   Rigid body, motion of rigid body. Analogy of linear and rotational motion description. Center of mass of a body.

10.   Moment of inertia of simple bodies, parallel axis theorem.

11.   Classification of dynamical systems (linear, nonlinear, autonomous, nonautonomous, conservative, continuous, discrete, one-dimensional, multidimensional, time-reversal, time-irreversal). Phase portraits, phase trajectory, fixed points, dynamical flow.

12.   Mathematical description of linear dynamical systems. Examination of linear system stability. Solution of sets of differential equations, use of a matrix calculus.

13.   Nonlinear systems. Numerical solution of differential equations. Linearization.

14.   Bifurcation, logistic equation.